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A FISHERIES EVALUATION OF THE SUNNYSIDE CANAL FISH SCREENING FACILITY, SPRING 1985

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A FISHERIES EVALUATION OF THE SUNNYSIDE CANAL FISH SCREENING FACILITY, SPRING 1985

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PREFACE

The Bonneville Power Administration (BPA) and the Bureau of Reclamation (BR) are providing funding to construct fish passage and protective facilities at 20 irrigation diversions in the Yakima River Basin, Washington. Construction implements section 904 (d) of the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program (NPPC 1984) which addresses natural propagation of salmon to help mitigate fish and wildlife losses caused by hydroelectric development throughout the Columbia River Basin.

The Sunnyside Canal Fish Screening Facility (Sunnyside Screens) is one of the protective facilities built by BPA. The screening facility diverts fish from the Sunnyside Canal back into the Yakima River. This report discusses results of a fisheries evaluation of the Sunnyside Screens. Studies were conducted where fish were placed upstream of or within the Sunnyside Screens and captured before they entered the river. Results indicate that fish are safely diverted by the facility from the canal to the river.

The study emphasized salmonids, and only steelhead, *Salmo gairdneri*, and spring chinook salmon smolts were tested. We did not test smaller zero-age fall chinook salmon, *Oncorhynchus tshawytscha*, which may also pass through the Sunnyside Fish Screening Facility. Testing was limited to conditions near full flow capacity for the canal.

ACKNOWLEDGMENTS

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ABSTRACT

The Sunnyside Canal Fish Screening Facility (Sunnyside Screens) is part of a joint project by the Bonneville Power Administration and the Bureau of Reclamation to Construct Fish passage and protective facilities at existing irrigation diversions in the Yakima River Basin. The project is part of the Northwest Power Planning Council's (NPPC) Columbia River Basin Fish and Wildlife Program. The construction implements Section 904 (d) of the NPPC plan which addresses natural propagation of salmon.

This is the first annual report for the fisheries evaluation of the diversion screens. This report summaries the evaluation of the work conducted at the Sunnyside Screens. About 4000 chinook salmon, *Oncorhyncus tshawytscha*, and 2000 steelhead, *Salmo gairdneri*, smolts were released in front of or within the Sunnyside Canal Fish Screening Facility. We caught 3625 chinook salmon and less than 2% were descaled or dead. We captured 507 of the steelhead and none were descaled or dead.

The Sunnyside Screens are in the Sunnyside Canal, about 360 m downstream of the Sunnyside Dam on the Yakima River (river kilometer 167). The screening facility diverts fish that have entered the canal back into the Yakima River. Descaling and mortality data were gathered by releasing branded fish into the canal, upstream of the facility, and capturing them before they returned to the river. Captured fish were anesthetized and examined for descaling that occurred during passage through the screening facility. The methods used for this evaluation were reviewed by the Washington State Department of Fisheries, U. S. Fish and Wildlife Service, National Marine Fisheries Service, Northwest Power Planning Council, and the Yakima Indian Nation.

GLOSSARY

Approach velocity	the rate at which water moves perpendicular through the face of a screen
Canal headgates	structure that controls the volume of river water that is diverted from the dam reservoir into the irrigation canal
Fish bypass system	that portion of the fish screening facility that collects fish moving along the screen and diverts them back to the river
Fish return pumps	two pumps on the separation chamber that pump fish return water from the separation chamber to the canal
Fish return water	water diverted through the screen facility into the secondary separation chamber and subsequently back into the river or into the fish return pumps
Flow control structure	that portion of the fish screening facility that regulates the velocity of the water through the fish bypass system
Intermediate bypass entrance	the opening midway in the screening structure that diverts about half the fish bypass water into the diversion
Intermediate bypass fish guidance wall	angled concrete wall that guides fish and water into the intermediate bypass entrance
Intermediate bypass pipe	steel pipe that carries water and fish from the intermediate bypass entrance to the separation chamber
Live-box	a container designed to hold live fish for an extended period of time

Primary fish return pipe	pipe that returns water and fish from the separation chamber to the river
Rotary screens	cylindrical wire mesh structures used to filter fish and debris from water entering the canal
Screen structure	the concrete structure that supports the rotary drum screens, and the fish bypass system
Secondary fish return pipe	auxiliary pipe to supplement return of water and fish to the river when fishwater return pumps are not working at full capacity
Separation chamber	open chamber at the terminus of the screen structure where 80% of the diversion water is returned to the canal and 20% of the diversion water and 100% of the fish are returned to the river
Separation screens	vertical traveling screens that prevent fish from being pumped from the separation chamber into the canal by the fishwater return pumps
Smolt	a salmonid lifestage in which the fish undergo physiological and behavioral changes and begin out-migrating from freshwater to the ocean
Sweeping velocity	rate at which water moves parallel to the face of a screen
Terminal bypass entrance	vertical slot passageway that carries or directs water from the terminus of the screen structure into the separation chamber
Trash rack	rack upstream of the fish screen structure to collect debris in the water and protect the screens

INTRODUCTION

The Yakima River Basin has historically supported a significant salmonid fishery. During the late 1800s, between 500,000 and 600,000 adult salmon, *Oncorhynchus* spp., and steelhead, *Salmo gairdneri*, returned to the Yakima River and its tributaries (Bureau of Reclamation 1984). There were runs of spring, summer, and fall chinook salmon, *O. tshawytscha*, coho salmon, *O. kisutch*, sockeye salmon, *O. nerka*, and steelhead.

Some of the runs are extinct or near extinction. Present spawning escapement averages about 2000 salmonids (Bureau of Reclamation 1984). There are no sockeye salmon migrating into the Yakima River Basin and in 1983 only 37 coho salmon passed the Prosser Diversion Dam (Hollowed 1984).

The decline in Yakima River Basin runs is the result of many factors. Spawning and rearing habitat has been reduced by construction and operation of diversion dams. Stream flow for fish has been inadequate because of conflicts with other water uses. Ineffective fish passage facilities for adults and juveniles at diversion dams have resulted in reduced survival during migration. Additionally, many Yakima River fish are killed while passing dams on the Columbia River.

The Pacific Northwest Electric Power Planning and Conservation Act (Public Law 96-501) was passed to prepare a regional Conservation and Electric Power Plan. The Northwest Power Planning Council administers the plan and is charged with developing a program to protect and enhance fish and wildlife and mitigate the effects of the development, operation, and management of hydroelectric facilities.

The Yakima River Basin was selected as a site for enhancement of salmon and steelhead runs in the Pacific Northwest. The Bonneville Power Administration (BPA) and the Bureau of Reclamation (BR) are funding the construction of fish passage and protection facilities at 20 existing irrigation diversions in the Yakima River Basin (Figure 1). BPA is also providing funds to the Yakima Indian Nation to develop methods to increase production of spring chinook salmon in the Yakima River Basin.

The Sunnyside Diversion Dam and Canal are part of the passage and protection facilities being constructed by BPA and BR. Construction of diversion screens in the canal was completed in the spring of 1985. Subsequently, BPA asked the Pacific Northwest Laboratory (PNL) to evaluate screen effectiveness in diverting

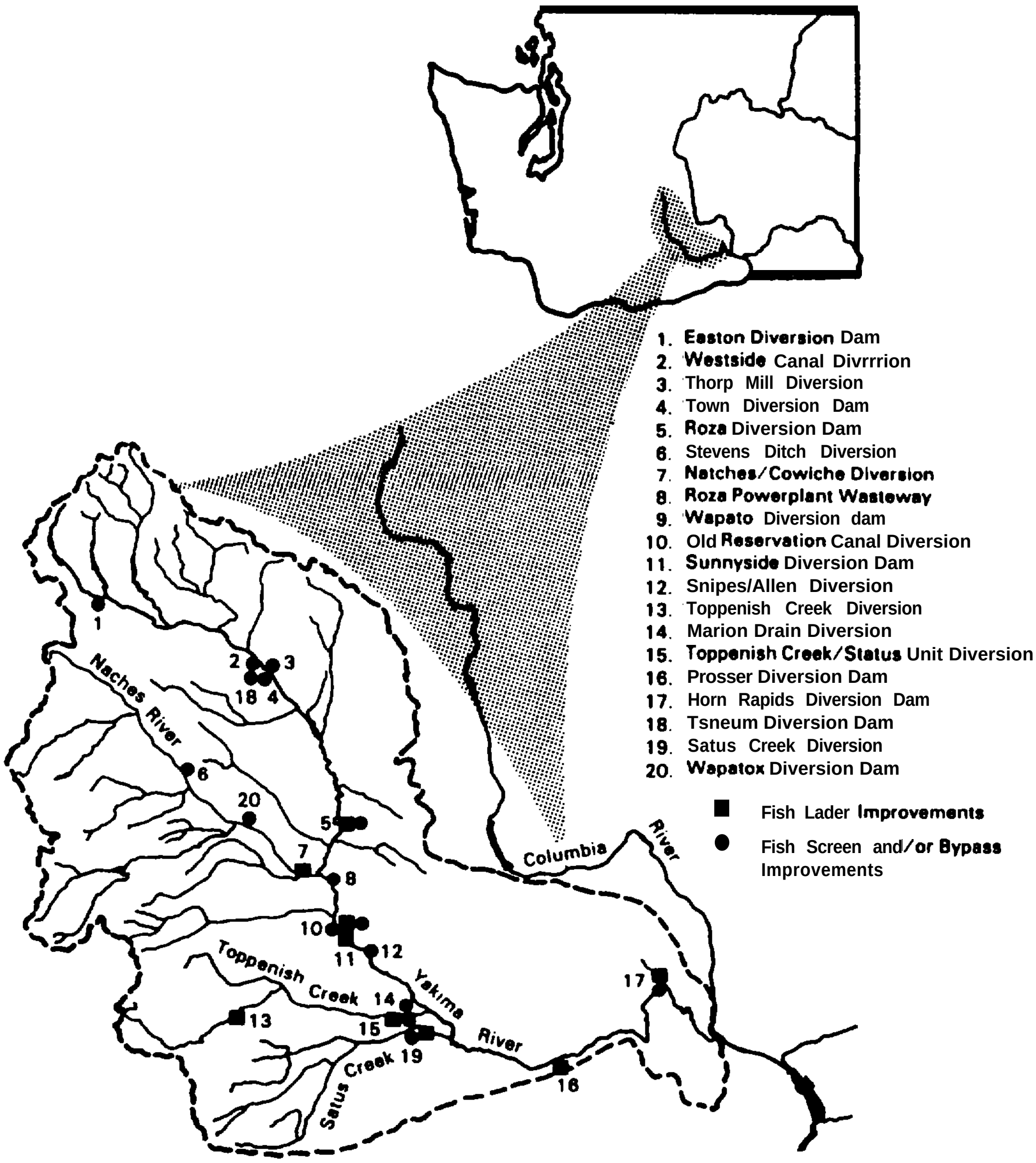


FIGURE 1. Map of Yakfma River Basin Including Locations of the Sunnyside Diversion Dam and Other Fish Protection and Passage Facilities

fish that had entered the Sunnyside Canal Dam back into the Yakima River. The Sunnyside Canal diverts up to 75% of the water from the Sunnyside Dam Reservoir.

This report describes work that PNL fisheries staff conducted at the Sunnyside Screens in 1985. The report describes the screening facility, methods used to evaluate the screens effectiveness, and the results of our studies.

DESCRIPTION OF THE STUDY AREA

The Sunnyside Diversion Dam and Canal are located on the Yakima River at river kilometer 167. The dam creates a reservoir in the Yakima River from which water is diverted into the Sunnyside Canal. Canal flow varies from 17 cubic meters/second (m^3/sec) to 37 m^3/sec during the irrigation season. Canal flow begins each year in late March or early April with the opening of the canal headgates (Figure 2). Canal flows are lowest in the spring and usually peak in July. Flows remain near maximum until late summer, when irrigation demand is reduced. The canal is emptied in October.

The Sunnyside Canal Fish Screening Facility (Sunnyside Screens) is located about 360 m downstream of the Sunnyside Canal

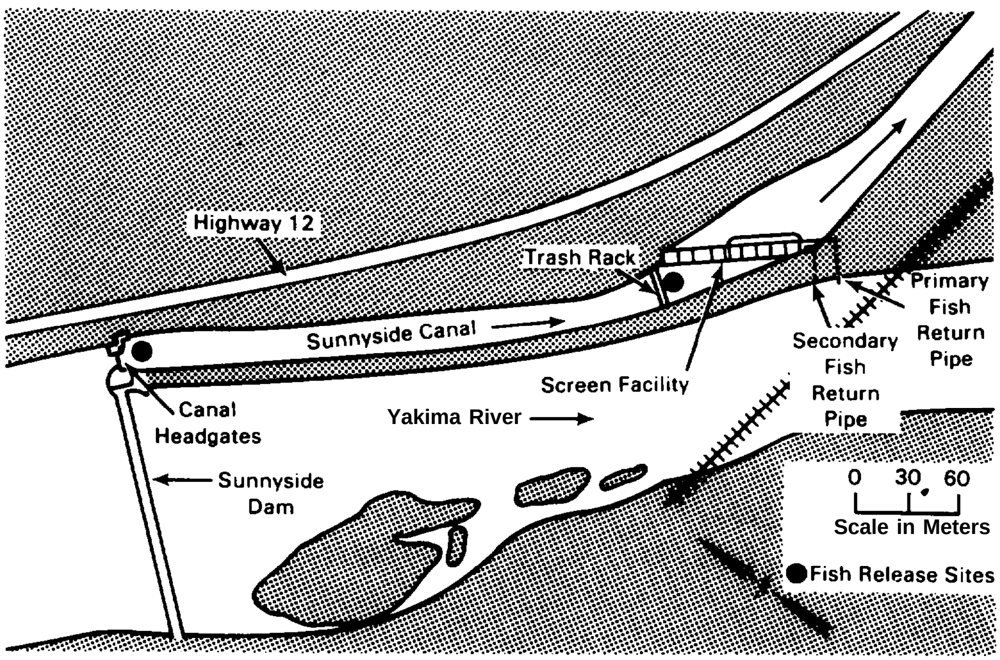
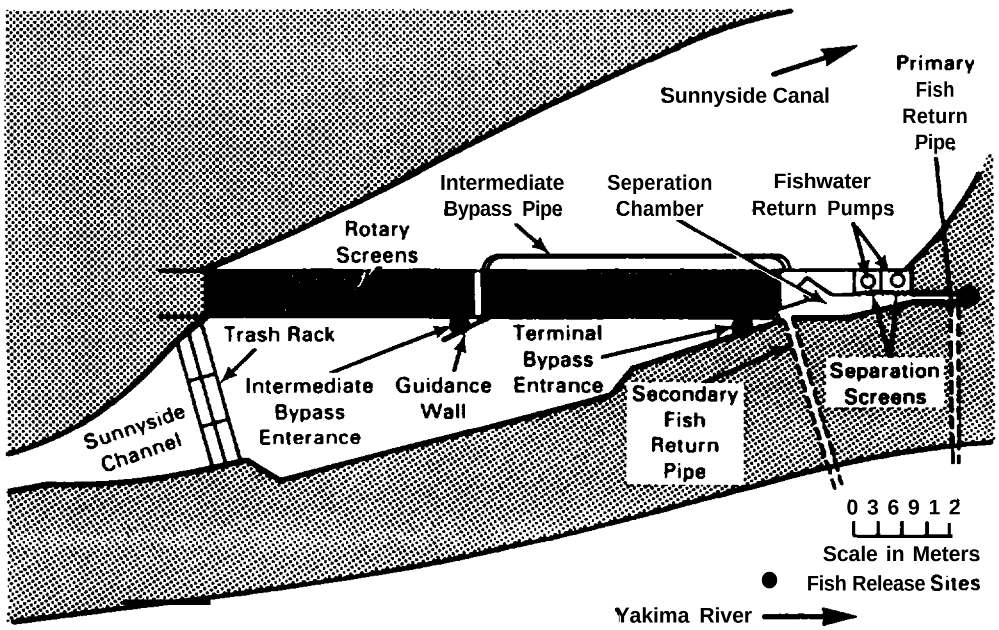


FIGURE 2. Aerial View of the Sunnyside Dam and Sunnyside Canal Fish Screening Facility

headgates. The screening facility prevents fish that are diverted into the canal from remaining in the canal and safely directs them back into the Yakima River.

A trash rack has been placed in the canal upstream of the screening facility (Figures 2 and 3) to "filter" out large debris that is diverted into the canal. The rack prevents large logs or tree branches from damaging the screens or interfering with the flow control through the screening facility.

The screening facility is made of concrete and houses 17 cylindrical screens (Figure 3) whose axes are parallel to the length of the structure. Each screen is about 3.5 m wide and 7.5 m in diameter. Water depth at the screens varies with canal flow. However, the average depth across the face of the screens is about 6.0 m.



<u>FIGURE 3</u>. Aerial View of the Flow Control Structure and Fish Bypass System in the Sunnyside Canal Fish Screening Facility

The screening facility also has a flow control structure and a separation chamber at the downstream end (Figure 3). Water and fish that are diverted past the front of the screens, toward the primary fish return pipe, pass through the flow control structure and separation chamber. During normal operation, about 2.8 m^3/sec of water and all fish are diverted into the separation chamber. Two fishwater return pumps are located near the terminus of the separation chamber. About 80% of the water entering the separation chamber is pumped into the canal. Traveling screens positioned between the pump intakes and the separation chamber prevent fish and debris from being entrained in the pumpback system. The fish and water, not pumped back into the canal, are directed back into the Yakima River via the primary fish return pipe.

The screening facility is oriented in the canal at a 26-degree angle to the canal flow. This orientation provides a differential between the approach velocity and the sweeping velocity at the screen. Approach velocity is that component of the water velocity perpendicular to the face of the screen (Easterbrooks 1984, Figure 4). Sweeping velocity is that component of the water velocity parallel to the screen face (Figure 4). During normal operation, the approach velocity is less than 0.014 m^3/sec and the sweeping velocity is greater than 0.057 m^3/sec. This velocity differential was incorporated into the screen design so fish will not be impinged on the screens, but will be safely guided into the flow control structure and back into the Yakima River.

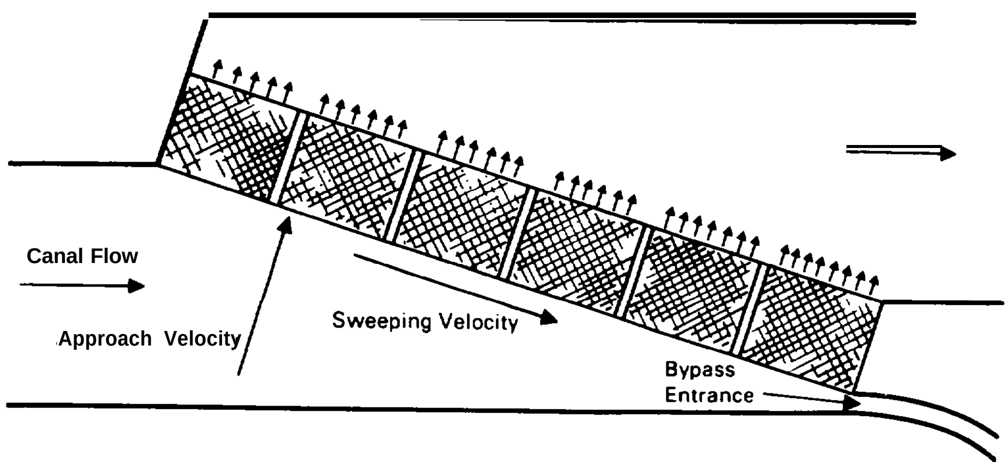


FIGURE 4. Approach and Sweeping Velocity Vectors Across Wire Mesh Screens

METHODS

Studies were conducted where fish were released upstream of the facility and captured at the terminus of tne flow control structure or the primary fish return pipe. The fish were evaluated for scale loss after capture. Some fish were held for post-test observation.

TEST FISH

Salmonid smolts, hatched and reared upstream of Sunnyside Dam, migrate downstream each year beginning in early spring and continuing through mid summer. Additionally, many smolts are released upstream of Sunnyside Dam as part of Yakima River Basin salmonid enhancement projects. Smolts that migrate past Sunnyside Dam may be diverted from the Yakima River into the Sunnyside Canal and must pass through the Sunnyside Screening Facility before returning to the river. Salmonid populations passing through the Sunnyside Screening Facility include both species tested; steelhead and spring chinook salmon.

Steelhead

Steelhead used in our studies were smolts that had an average weight of 11 to 13 fish/kg and an average fork length (FL) of 16 cm to 23 cm. Fish were obtained from the Washington State Department of Game (WDG) and were from stocks designated for planting in the upper Yakima River Basin. The steelhead were hatched at the WDG Naches Trout Hatchery and reared at the Nelson Spring Rearing station. The fish were cold branded and their adipose fin was clipped. The brand was a 1.25-cm x 0.2-cm bar applied horizontally above the lateral line in one of four locations: ri ht or left anterior (RA, LA), or right or left posterior (RP, LP4. Branded fish were held at the Naches Trout Hatchery until their release at the Sunnyside Screens.

Chinook Salmon

Chinook salmon used in our studies were smolts that had an average weight of 31 to 35 fish/kg and an average FL of 12 cm to 16 cm. They were obtained from the U.S. Fish and Wildlife Service, Leavenworth National Hatchery. The fish were cold branded, wire coded tagged (Code # 5-17-5), and their adipose fin was clipped. The brand was a 1.25 cm x 0.2 cm bar applied horizontally above the lateral line in one of four locations: RA, LA, RP, LP. The branded fish were held at the Leavenworth National Hatchery until their release at the Sunnyside Screens.

SAMPLING EQUIPMENT

The study objectives required that released fish be captured within the screening facility and at the terminus of the primary fish return pipe. This was accomplished with the development of an inclined plane and fyke net that were custom fit to the Sunnyside Screens. Sampling equipment also included facilities for holding fish for post-testing observations.

Inclined Plane

Fish were captured by placing an inclined plane in the flow control structure (Figure 5). The plane was made of stainless steel and was designed to fit snugly into the terminus of the flow control structure. The plane was 4.6 m long and 0.6 m wide; the surface area of the plane was about 2.6 m^2. The frame of the plane was made from 1.3 cm x 7.6 cm steel bar that was braced with steel bars welded at almost equidistant intervals along the length of the frame. Steel bars 2.5 cm wide and 4.6 m long were added to the top of the frame to filter fish from the water. The bars were bent in the middle along their length at a 45 degree angle and welded to the frame, angle apex facing away from the frame. The spacing between the bars was 0.63 cm. A live-box constructed of stainless steel (1.2 m x 0.6 m, 100 1 capacity) was fastened to the downstream end of the plane.

Water flow was directed over the plane by placing dam boards in the upstream stoplog slots of the flow control structure terminus. The dam board was 66 cm wide and 2.5 m high. The upstream end of the plane was bolted to the top portion of the dam board. The level of the plane was adjustable. The plane was lowered into the flow control structure with a winch until the surface of the plane was completely submerged and the flow of water entering the live-box was sufficient to "lift" fish from the plane into the box.

Fyke Net

Fish were captured at the terminus of the primary fish return pipe with a 6.0 m long fyke net (Figure 6) made of 1.0-cm-mesh knotless nylon netting. The net mouth was 1.2 m x 2.3 m tapering to a 25 cm x 63 cm cod end. A zipper was installed in the cod end of the net to accommodate the removal of fish.

Holding Facilities

Four fiberglass fish troughs were installed on site at the Sunnyside Screens. The troughs were 3 m long, 0.6 m wide, and 0.3 m deep (1000 1 capacity). Water was supplied to the troughs at

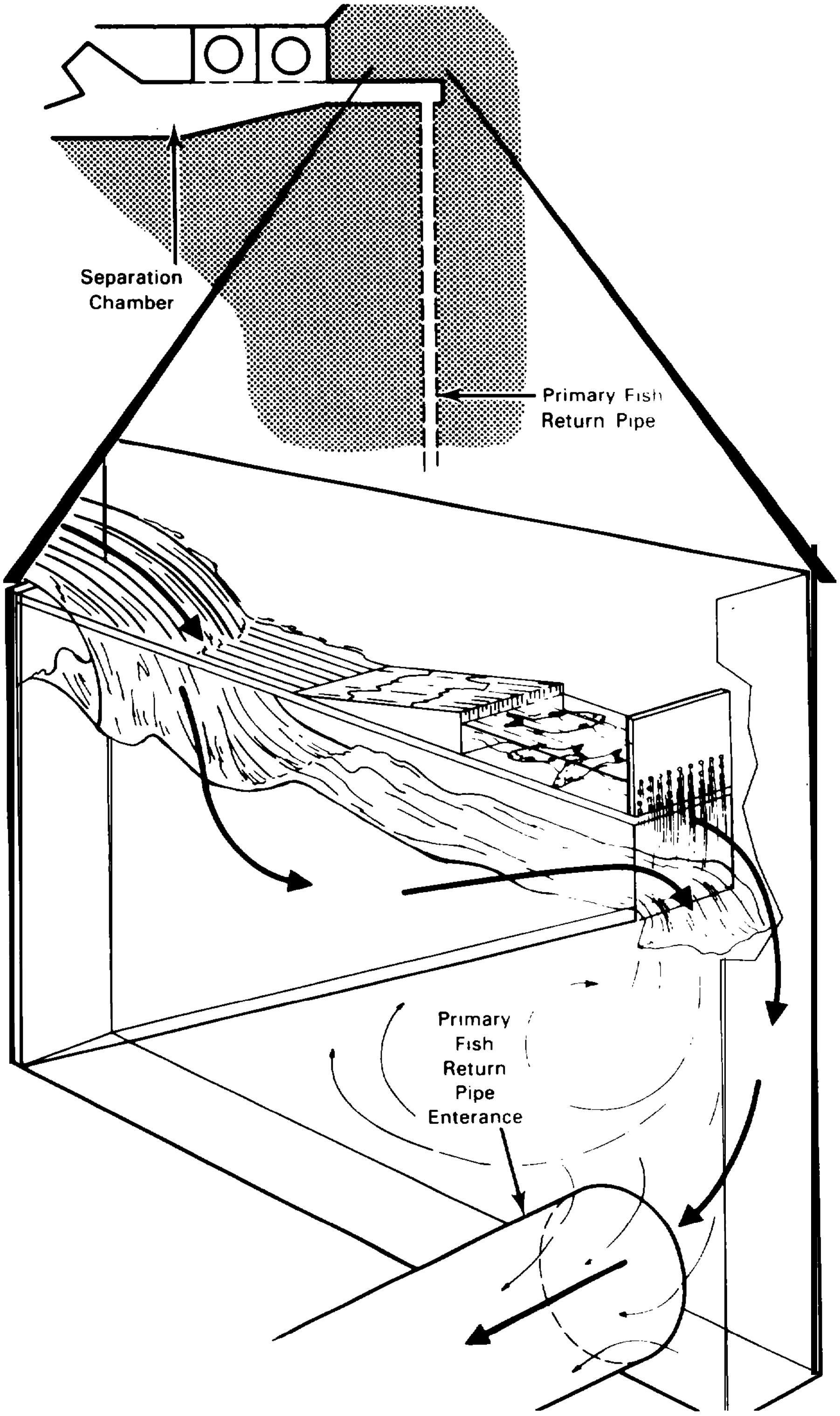


FIGURE 5. **Inclined Plane System Used at the Sunnyside Canal Fish Screening Facility, Spring 1985**

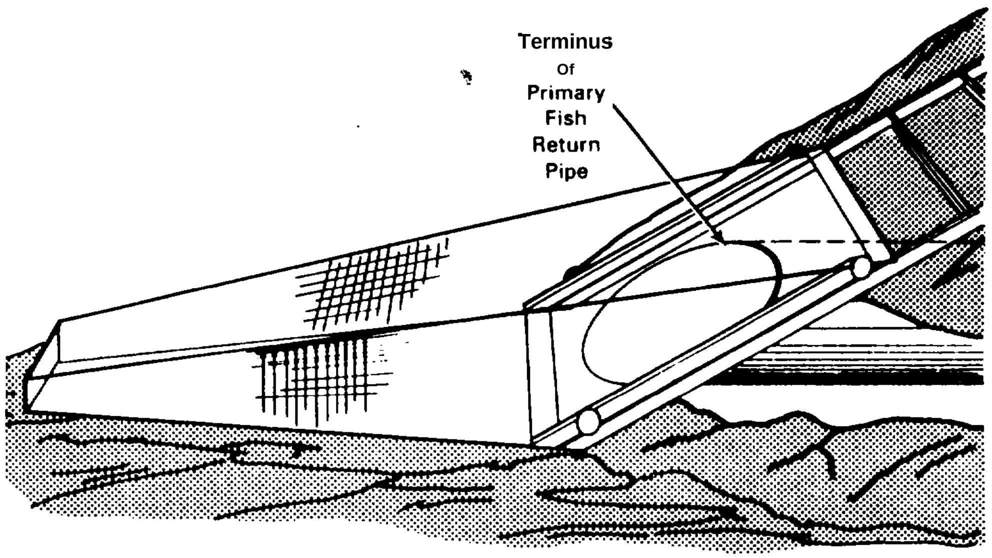


FIGURE 6. Fyke Net Used at the Sunnyside Canal Fish Screening Facility, Spring 1985

20 1/min from the fishwater return pumps. Fish were held in the troughs after removal from the live-box or net until their scale condition was evaluated. Some fish were held in the troughs for post-test observations.

DESCALING EVALUATION

The system developed by the U.S. Army Corps of Engineers (Basham et al. 1982) was used to evaluate the scale condition of fish at the Sunnyside Screens. The evaluation criteria included modifications established in early 1985 (Appendix A). A baseline descaling condition was determined by randomly sampling the test populations prior to release.

The extent of scale loss was determined by examining the descaling that occurs in each of ten equal areas, five on each side of the fish (Figure 7). If 40% or more scale loss is observed in any two areas on one side of a fish, the fish was classified as descaled. A sample score sheet is also shown in Appendix A.

FIGURE 7. Division of Body Areas to Evaluate Scale Loss on Salmonids at Sunnyside Canal Fish Screening Facility, Spring 1985

TEST PROCEDURE

Fish were released either in the canal or within the screening facility depending on the test objective. Fish were released into the canal to quantify descaling and mortalities caused by the entire screening facility (canal headgates to the river). Fish were released within the screening facility to identify screening components downstream of the rotating screens that might descale or kill fish. Additionally, fish passage time through the screening facility and identification of possible predator populations within or near the Sunnyside Screens were monitored.

Fish Transport and Release

Test fish were transported by truck in an insulated tank (400 1 capacity) supplied with oxygen. Transit time from Naches and Leavenworth to the Sunnyside Screens was 0.5 h and 2.5 h, respectively. Loading densities during transport did not exceed 120 g of fish/l. No losses attributable to transport were observed for steelhead and less than 1% loss occurred with the chinook salmon.

Test fish were released directly from the transport tank into the canal or screening facility either through a 10 cm diameter plastic tube attached to the transport tank or by dip net.

Fish Release Locations

Fish were released at two locations in the Sunnyside Canal: downstream of the canal headgates and downstream of the trash racks (Figure 2). Fish were released at three locations within the flow control structure: in the intermediate bypass entrance, the terminal bypass entrance, and at the terminus of the flow control structure (Figure 3).

Release Controls

Before release, 10 to 50 fish were randomly sampled from the group. These fish were anesthetized and evaluated for scale loss or injury to segregate transport and hatchery descaling from descaling caused by the screening facility. Fish were also released on the inclined plane or placed in the net to determine scale loss resulting from the sampling equipment.

Fish Capture and Evaluation

Captured fish were dip netted from the live box on the inclined plane with a net and placed in a holding trough. Fish were then anesthetized with MS-222, scale loss was evaluated, and fish were returned to the holding troughs. Some fish were held for post-test observation to determine the potential for delayed mortality. After fish had recovered from the anesthetic and the post-test observations were complete, fish were returned to the Yakima River.

STATISTICAL ANALYSIS

Estimates of the percent of fish descaled or killed were based on the number of test fish that were caught. Descaled fish were considered as dead for evaluation of the results. Confidence intervals for these estimates were calculated from Mainland's Tables (Mainland et al. 1956). Data for replicate tests were combined to obtain a mean estimate. The estimate assumes each fish behaved independently (i.e. fish within a test did not behave more similarly than fish between tests and there were no interactions among fish within a test). Although some interaction is expected among fish, it is an assumption necessary for the analytical methods used. All tests were conducted in the same manner to reduce non-independent behavior of fish.

RESULTS AND DISCUSSION

The results of our tests indicate that fish pass safely through the Sunnyside Screen Facility. The objectives and results of each of the tests are discussed below. A detailed summary of the catch data and the estimates for percent ot test fish that were descaled or killed are presented in Appendix B.

RELEASE AND CAPTURE TESTS

Thirty groups of fish were released at five different locations. A total of 4492 chinook salmon were released; 3625 were subsequently captured and 1672 steelhead were released; 507 were captured. Less than 2% of the chinook salmon were descaled or killed. These losses are well within the 95% confidence interval for the condition of the controls (Appendix B). None of the steelhead were descaled or killed.

Primary Fish Return Pipe

Test fish survived passage through the primary fish return pipe to the river. The pipe is the last component of the flow control structure; it is 21 m long and 1.2 m in diameter. Flow rate through the pipe is about 0.6 m^3/sec. During normal operation all fish diverted from the canal toward the river pass through'the primary fish return pipe.

The effect of passage through the primary fish return pipe was evaluated independently from the rest of the flow control structure because the inclined plane operated most efficiently upstream of the pipe entrance. None of the steelhead and 0.8% of the chinook salmon were descaled or killed after passing through the pipe (Tables 1 and 2).

Intermediate Bypass Entrance

Test fish survived passage through the intermediate bypass entrance. During normal operation, flow through this bypass entrance is about 1.4 m^3/sec. Assuming a uniform distribution, upstream of the screens, half the fish that are diverted into the canal will enter the intermediate bypass.

Fish that enter the flow control structure at the intermediate bypass entrance may pass eight of the rotating screens (Figure 2). These fish will have to pass the intermediate bypass entrance guidance wall, the intermediate bypass pipe, the secondary separation chamber, and the primary fish return pipe before returning

TABLE 1. Descaling and Mortality Data from Release and Capture Tests with Chinook Salmon, *Oncorhynchus tshawytscha*, Smolts at the Sunnyside Canal Fish Screening Facility, Spring 1985

RELEASE SITE	NUMBER OF FISH RELEASED	CAPTURED	DESCALED OR KILLED	FISH DESCALED OR KILLED (%)	95% CONFIDENCE INTERVAL
FISH RETURN PIPE	500	371	3	0.8	0.2-2.3
INTERMEDIATE BYPASS	500	468	4	0.9	0.2-2.2
TERMINAL BYPASS	492	476	7	1.5	0.6-3.0
TRASH RACK	1000	856	20	2.3	1.4-3.6
CANAL HEADGATES	2000	1454	28	1.9	1.3-2.8

TABLE 2. Descaling and Mortality Data from Release and Capture Tests with Steelhead, *Salmo gairdneri* Smolts at the Sunnyside Canal Fish Screening Facility, Spring 1985

RELEASE SITE	NUMBER OF FISH RELEASED	CAPTURED	DESCALED OR KILLED	FISH DESCALED OR KILLED (%)	95% CONFIDENCE INTERVAL
FISH RETURN PIPE	172	30	0	0	0-11.6
INTERMEDIATE BYPASS	275	139	0	0	0-2.6
TERMINAL BYPASS	200	112	0	0	0-3.2
TRASH RACK	500	126	0	0	0-2.9
CANAL HEADGATES	500	100	0	0	0-3.6

to the river. None of the steelhead and 0.9% of the chinook salmon were killed or descaled during tests through the intermediate bypass entrance (Tables 1 and 2).

Terminal Bypass Entrance

Test fish survived through the terminal bypass entrance. During normal operation, flow through this bypass entrance is about 1.4 m^3/sec. Assuming a uniform distribution, upstream of the screens, half of the fish that are diverted into the canal will enter the terminal bypass entrance.

Fish that enter the flow control structure at the terminal bypass entrance may pass nine of the rotating screens (Figure 2). These fish will have to pass by or through the terminal bypass entrance, the secondary separation chamber, and the primary fish return pipe before being returned to the river. None of the steelhead and 1.5% of the chinook salmon were killed or descaled during tests through the terminal bypass entrance (Tables 1 and 2).

Trash Rack

Test fish survived passage to the river after release downstream of the trash rack. During normal operation, fish pass through the trash rack and into the flow control structure at the intermediate or terminal bypass entrance. All fish that enter the canal and return to the river through the primary fish return pipe pass through the trash rack. Fish downstream of the trash rack have passed from the canal headgates to within 3 m to 60 m of the rotating screens (Figure 2). These fish may pass nine rotating screens. Before returning to the river the fish must pass through the flow control structure and the primary fish return pipe. None of the steelhead and 2.3% of the chinook salmon were killed or descaled during passage through the trash rack (Tables 1 and 2).

Canal Headgates

Test fish survived passage to the river after release downstream of the canal headgates. Assuming uniform fish distribution above Sunnyside Dam, about 75% of the fish in the Yakima River may be diverted through the Sunnyside Canal Fish Screening Facility. Flow through the canal ranges from about 17 m^3/sec to 37 m^3/sec during the irrigation season (March through October). Yakima River flow at Sunnyside Dam can vary from 3 m^3/sec to 425 m^3/sec during the same period. Water use agreements have established a minimum flow of 6 m^3/sec across Sunnyside Dam, when possible. Therefore, up to 75% $(17/(6+17)\times100=75)$ of the Yakima River may be diverted into the Sunnyside Canal.

Water diverted into the Sunnyside Canal at Sunnyside Dam enters through the canal headgates. All fish that enter the canal enter through the canal headgates and pass through about 360 m of canal before reaching the screen structure. In our tests, none of the steelhead and 1.9% of the chinook salmon were killed or descaled during passage through the canal headgates (Tables 1 and 2).

DESCALING OF HATCHERY-RELEASED AND NATIVE FISH

During our tests, we collected many hatchery-released and native Yakima River fish. Two hundred and fifty salmonids were anesthetized and checked for scale loss (Table 3). Ten fish were descaled. Although the condition of the fish entering the canal headgates is unknown, the number of descaled fish indicates that the Sunnyside Screens are not descaling fish as they are diverted from the canal back to the Yakima River.

TABLE 3. Scale Loss for Hatchery-Released and Native Fish Captured during Tests at the Sunnyside Canal Fish Screening Facility, Spring 1985

DATE COLLECTED	SPECIES	ORIGIN	NUMBER COLLECTED	NUMBER DESCALED
April 30	chinook salmon	hatchery	14	0
April 30	chinook salmon	native	28	1
April 30	steelhead	hatchery	1	0
April 30	steelhead	native	4	0
May 9	chinook salmon	hatchery	25	0
May 9	chinook salmon	native	4	0
May 13	chinook salmon	hatchery	5	0
May 13	chinook salmon	native	2	0
May 13	steelhead	native	1	0
May 16	chinook salmon	hatchery	17	1
May 16	chinook salmon	native	12	1
May 16	steelhead	hatchery	4	0
May 16	steelhead	native	3	0
May 17	chinook salmon	hatchery	35	1
May 17	chinook salmon	native	30	3
May 17	steelhead	hatchery	1	0
May 17	steelhead	native	2	0
May 28	chinook salmon	hatchery	22	2
May 28	chinook salmon	native	20	0
May 28	steelhead	hatchery	8	0
May 28	steelhead	native	12	1

FISH PASSAGE TIME THROUGH THE SCREENING FACILITY

The rate at which fish move through the screen facility depends on the migratory behavior of a species, time of day, and release location. We recorded the the amount of time required or taken for fish that we released into and upstream of the screening facility. If fish are attracted to or are unable to swim out of the screening facility they are lost to the enhancement efforts in the Yakima River Basin. Canal flow does not appear to "flush" fish through the facility, however test fish did not appear to residualize in the screening facility.

Chinook salmon released into the canal moved to the inclined plane quicker than steelhead. Releases of 500 steelhead were made at the canal headgates and at the trash rack. Sixty-seven hours after release, 20% of the steelhead released at the canal head-gates and 25% of the steelhead released at the trash rack were captured (Figures 8 and 9). Two releases of 1000 chinook salmon each were made at the canal headgates and one at the trash rack. Twenty-two hours after the first canal headgates release, 76% of the fish were captured; 16 hr after the second release, 73% of the fish were captured. Sixteen hours after chinook salmon were released at the trash rack, 82% were captured (Figures 10-11).

Although releases were not made at the same time the results suggest that the steelhead remained in the canal longer than chinook salmon. The difference in behavior may reflect species differences, size differences, or stage of smolt transformation; steelhead, appeared to have lost some of their external smolt characteristics at the time of their release into the canal.

Movement of steelhead and chinook salmon appeared to be influenced by time of day or photoperiod. Steelhead were more likely to enter the inclined plane between 2000 hr and 0400 hr (Figures 8 and 9). For the two steelhead releases into the canal, 77% and 84% of the fish were captured between 2000 hr and 0800 hr. Chinook salmon were more likely to move into the inclined plane between 0400 hr and 0800 hr (Figures 10-11). For the three chinook salmon releases, 23% 32%, and 40% of the fish were captured between 0400 hr and 0800 hr. Although the correlation between time of day and capture is not as evident for chinook salmon as for steelhead, the trend toward early mronin movement appears in the percent caught over time (Figures 10-114. The trend is also indicated by comparing the catch per unit effort presented as a percent of released fish that were remaining to be caught (Figures 12-14).

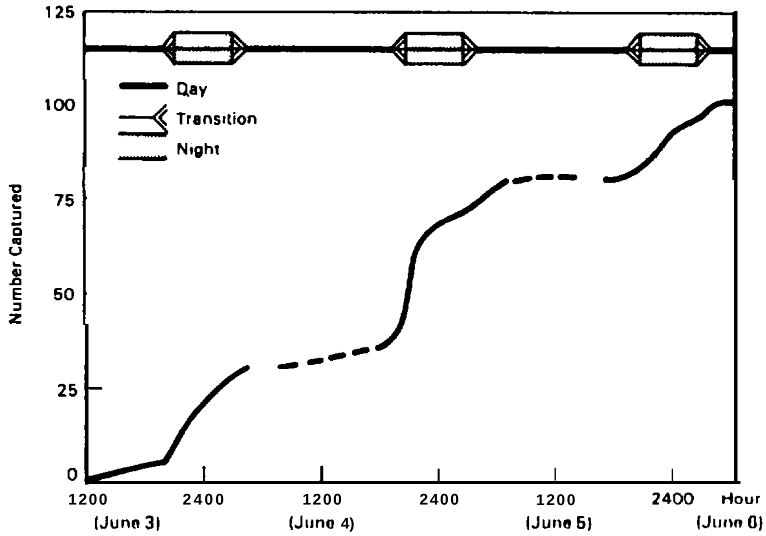


FIGURE 8. **Timing of Capture for Steelhead, *Salmo gairdneri*, Released Downstream of the Canal Headgates at Sunnyside Canal Fish Screening Facility, Spring 1985**

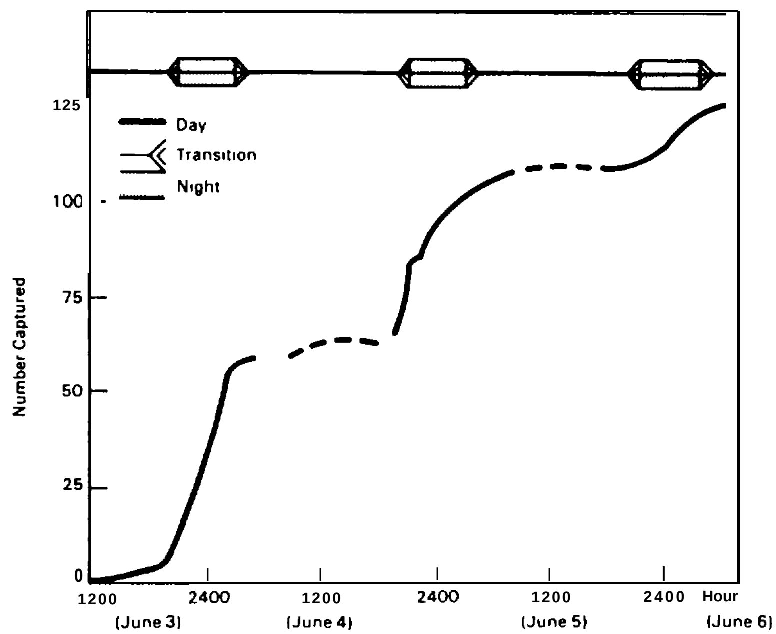


FIGURE 9. **Timing of Capture for Steelhead, *Salmo gairdneri*, Released Downstream of the Trash Rack at the Sunnyside Canal Fish Screening Facility, Spring 1985**

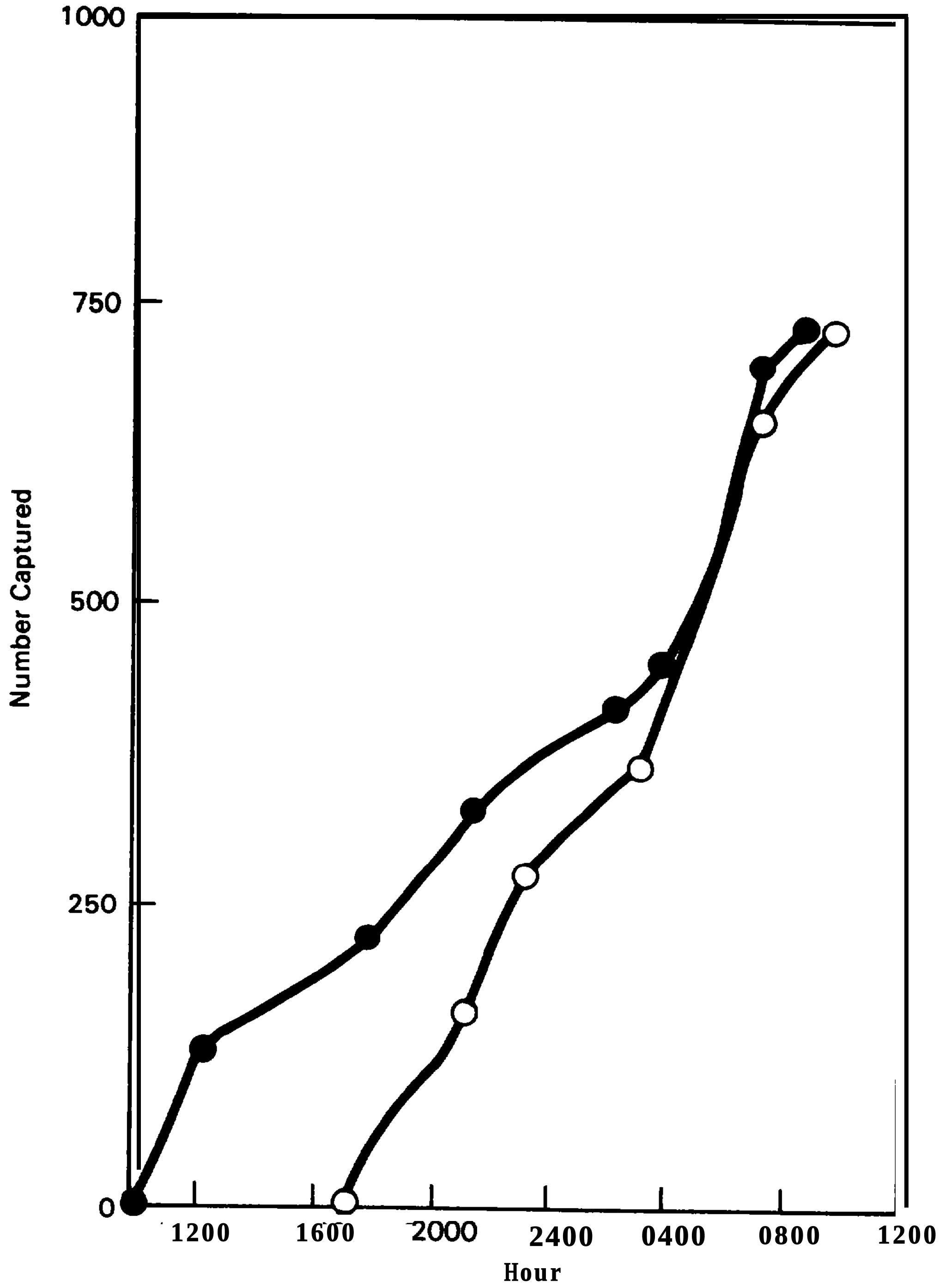


FIGURE 10. Timing of capture for Chinook Salmon, *Oncorhynchus tshawytscha*, Released Downstream of the Canal Headgates at the Sunnyside Canal Fish Screening Facility, Spring 1985 (● June 11 test, o June 19 test)

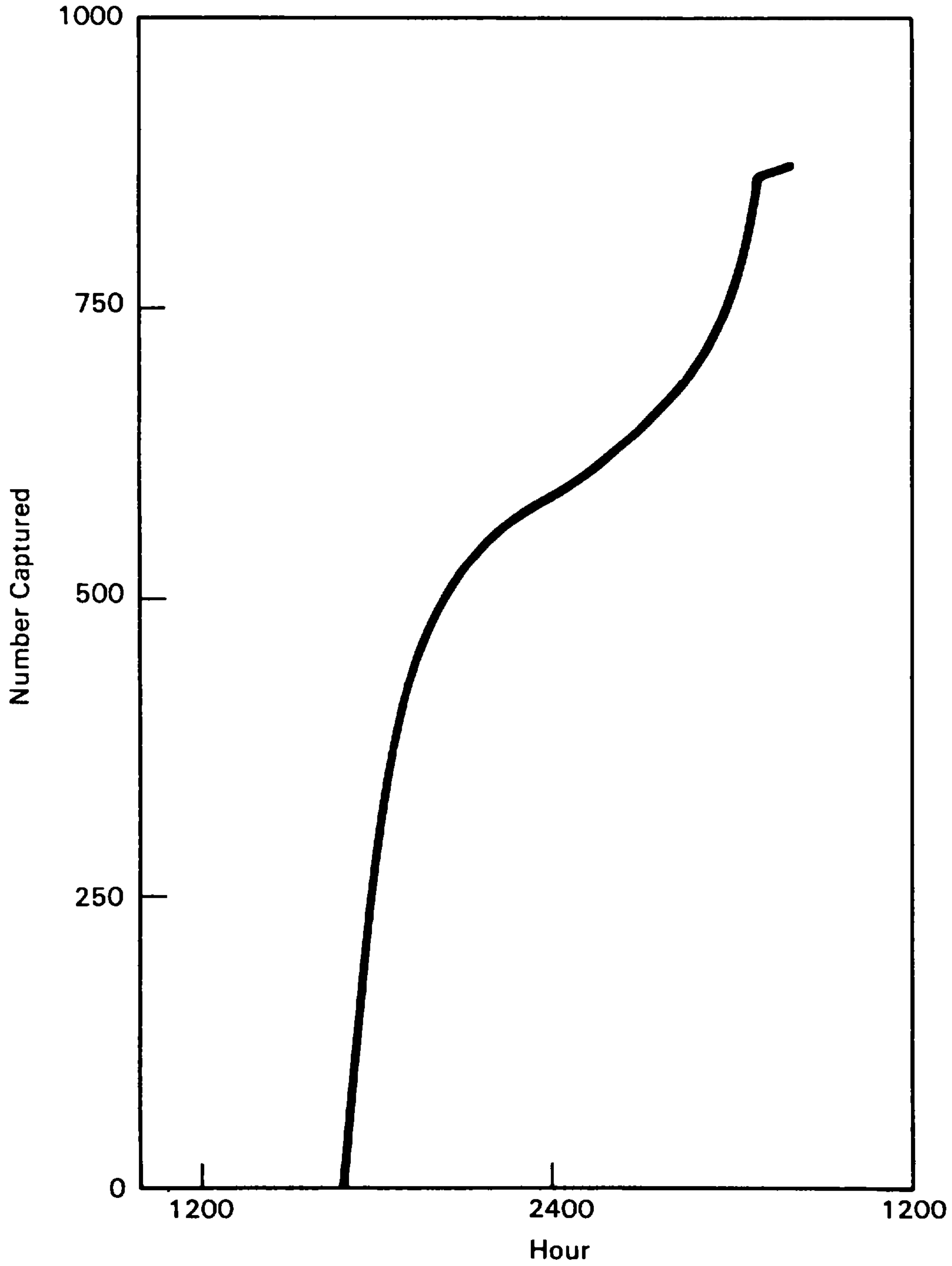


FIGURE 11. Timing of Capture for Chinook Salmon, *Oncorhynchus tshawytscha*, Released Downstream of the Trash Rack at Sunnyside Canal Fish Screening Facility, Spring 1985

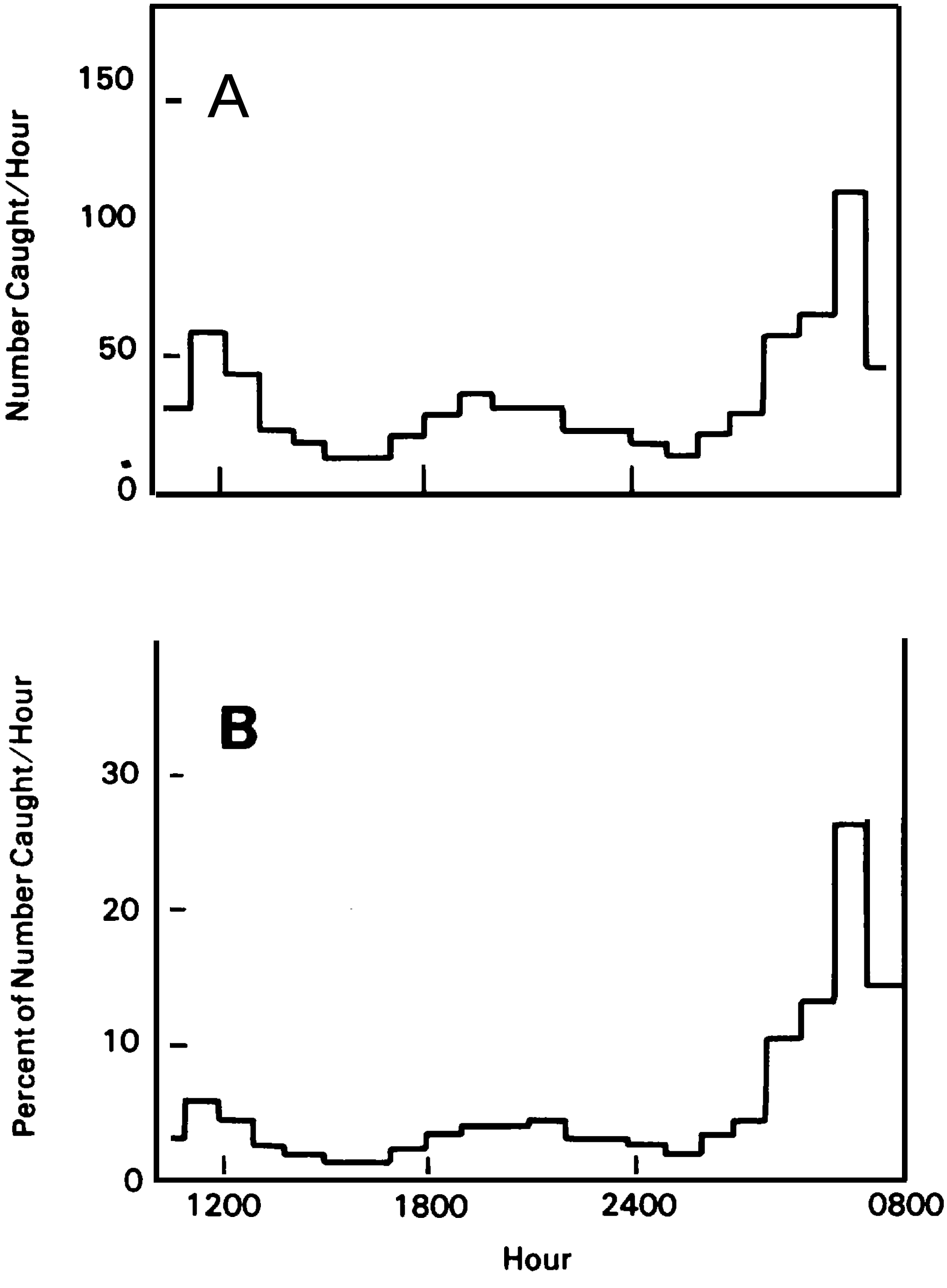


FIGURE 12. Catch Per Unit Effort for Chinook Salmon, *Oncorhynchus tshawytscha*, as A) Number of Fish Captured in Each Sample and B) as a Percent of the Released Fish that Were Remaining to be Captured (Canal Headgates Test June 11, 1985)

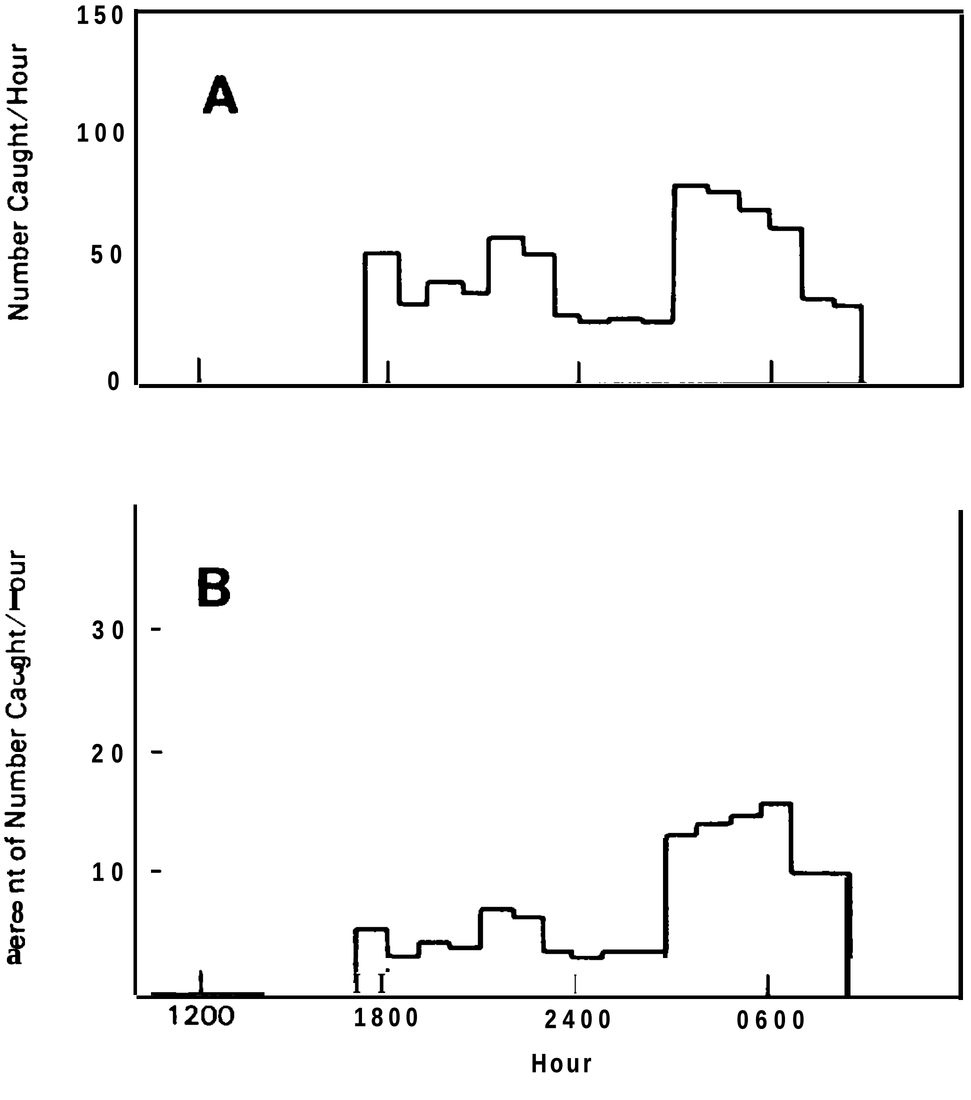


FIGURE 13. Catch Per Unit Effort for Chinook Salmon, Oncorhychus tshawytscha, as A) Number of Fish Captured in Each Sample and B) as a Percent of the Released Fish that Were Remaining to be Captured (Canal Headgates Test June 19,1985)

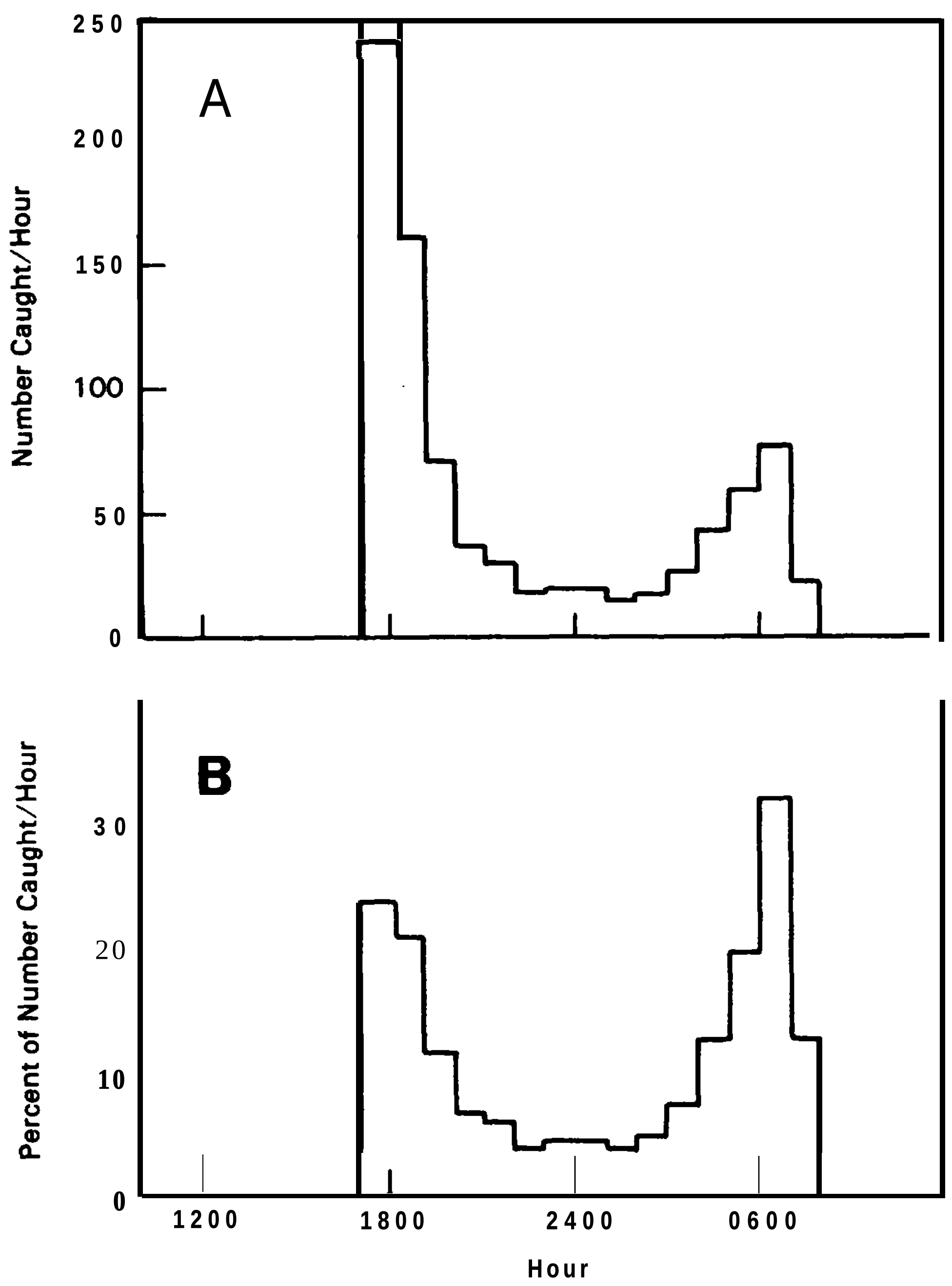


FIGURE 14. Catch Per Unit Effort for Chinook Salmon, Oncorhychus tshawytscha, as A) Number of Fish Captured in Each Sample and B) as a Percent of the Released Fish that Were Remaining to be Captured (Trash Rack Test, Spring 1985)

PREDATION

Piscivorous predators did not concentrate upstream of the Sunnyside Screens. Few predators were captured during our studies with steelhead and chinook salmon. Most nonsalmonids collected were chiselmouth, *Acrocheilus alutaceus*, and suckers, *Catostomus* spp. There were no concentrations of birds at the canal headgates or the terminus of the fish return pipe. There were some kingfishers, *Megaceryle alcyon*, observed near the railroad trestle downstream of the primary fish return pipe They were feeding in the pools and riffles on the opposite side'of the river from the screen facility.

SUMMARY

Release and capture tests were conducted at the Sunnyside Canal Fish Screening Facility (Sunnyside Screens) with chinook salmon and steelhead smolts to evaluate the effectiveness of the screens in safely diverting fish from the Sunnyside Canal to the Yakima River. We concluded that fish are safely diverted from the Sunnyside Canal to the Yakima River by the Sunnyside Screens.

This conclusion is based on the results of our tests.

- Chinook salmon and steelhead smolts released upstream of or into the Sunnyside Screens were safely diverted to the Yakima River.

- Less than 4% of the hatchery-released and native fish collected alive and evaluated during our tests were descaled.

- Smolts pass through the Sunnyside Screen Facility of their own volition. Fish that we released into the canal and other fish that entered the canal through the canal headgates were not trapped nor did they seem to be attached to any portion of the canal.

- Smolt movement occurred mainly at night.

- Concentrations of piscivorous predators were not observed in or near the Sunnyside Screens.

Field tests were conducted by the Pacific Northwest Laboratory for the Bonneville Power Administration. Tests were conducted to assess: fish condition after passage through the screen facility, passage time for fish migrating through the screen facility, and possible loss of diverted fish to predators.

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APPENDIX A

CRITERIA USED TO EVALUATE FISH DESCALING AT THE SUNNYSIDE CANAL FISH SCREENING FACILITY, SPRING 1985

CRITERIA USED TO EVALUATE FISH DESCALING AT THE SUNNYSIDE CANAL FISH SCREENING FACILITY, SPRING 1985

Salmonid smolt condition is evaluated by estimating the percentage of scales that have been lost. An evaluation system was standardized for use at screening and bypass systems at Columbia and Snake River dams. The system was developed by fisheries agencies that conduct the evaluations (Basham et al. 1982, Raleigh and Chapman 1983). The evaluation assumes that fish that have been descaled will not survive to return upstream as adults (Park et al. 1982, Basham et al. 1982). The evaluation system provides a common standard for fisheries workers in the Pacific Northwest.

This appendix contains a list of descaling criteria, a standardized score sheet for recording the data, and a list of suggested modifications that were to be applied on a trial basis during the 1985 salmonid outmigration. Pacific Northwest Laboratory researchers who evaluated fish at the Sunnyside Canal Fish Screening Facility recorded data using both sets of criteria; however, data presented in this report were collected using on the pre-1985, non-trial standards. The supplementary data were collected for possible future use.

Fish scale condition is evaluated by visually dividing the fish into ten approximately equal areas, five on each side (Figure A.1). All areas of the fish are examined for scale loss, except for the ventral surface from the pectoral fins to the vent. The degree or extent of descaling was noted for each fish, as follows:

- If scale loss was ≤3% in any or all areas, fish condition was noted as "OK".
- If scale loss was scattered (diffuse) and >3% but <40% per area, the fish was noted as an Right 6 (R6) and/or a Left 6 (L6) depending on which side the scale loss occurred.
- If scale loss was in localized areas (patchy) and >3% but <40% per area, an R6P or an L6P was noted depending on which side the scale loss occurred.
- If scale loss was ≥40% in one or more areas, each area with a ≥40% scale loss was noted by recording the side (R or L) and the area (l-5) that were descaled.
- If the fish had an eye or head injury, an R7 and/or L7 was noted.

Juvenile Descaling

Date________.

LOWER GRANITE　　　　Facility Sample

LITTLE GOOSE　　　　Gatewell ________________.

Remarks____

____

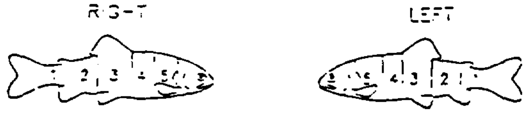
____.

ADDITIONAL CATEGORIES

6 (Scattered)　　　　7 (Eye or Head Injury)

6P (Patches)　　　　8 (Cut or Bruised)

9 (CUMULATIVE, Longitudinal Band)



OK		CHINOOK	OK		HATCHERY STEELHEAD	OK		WILD STEELHEAD
	1			1			1	
	2			2			2	
	3			3			3	
	4			4			4	
	5			5			5	
	6			6			6	
	7			7			7	
	8			8			8	
	9			9			9	
	10			10			10	
	11			11			11	
	12			12			12	
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	14			14			14	
	15			15			15	
	16			16			16	
	17			17			17	
	18			18			18	
	19			19			19	
	20			20			20	
	21			21			21	
	22			22			22	
	23			23			23	
	24			24			24	
	25			25			25	

TOTAL FISH SAMPLED ________　　TOTAL FISH SAMPLED ________　　TOTAL FISH SAMPLED ________

TOTAL DESCALED ___ % DESCALED ___　　TOTAL DESCALED ___ % DESCALED ___　　TOTAL DESCALED ___ % DESCALED ___

FIGURE A.1. Descaling Evaluation Data Sheet Used at Sunnyside Canal Fish Screening Facility, Spring 1985

1 If the fish was fungoused or dead, an 8 was noted. The 8 designation in the 1985 trial criteria was used to note bruised or cut fish (Figure A.2).

DESCALED FISH INCLUDE ONLY THOSE FISH WHOSE SCALE LOSS IS ≥40% IN AT LEAST TWO AREAS ON ONE SIDE.

In 1985, a modified criterion was added to the evaluation procedure (Figure A.2). The criterion was added to include tish in the descaled category that have scale loss of ≥40% on one side but do meet the "two area on a side" criterion. This condition was noted by some observers at Columbia River dams. The criterion is described as follows:

If the summation of scale loss is ≥40% of two or more sections on one side of the fish it should be considered descaled and shall be designated separately With the number 9.

Additional modifications to the criteria included the inclusion of cut and bruised fish in those designated as 8's. These fish should show severe signs of trauma: i.e. black or discolored bruises the size of a dime or cuts which show obvious flesh.

IDAHO FISH & GAME

Region 2
1540 Warner Avenue
Lewiston, Idaho 83501
Telephone: (208) 743-6502

Recieved
25 Mar 85
XC EWL
CSA

March 22. 1985

To: All Project Biologists
From: FTOT Chairman SWP
Subject: Juvenile descaling format

Ouring the FTOT Pre-season Metting at Walla Walla, descaling criteria was discussed. It was agreed that a new cirteria was needed, and that several new categories could be added to the items that we record (in addition to descaling).

We found that there was no criteria for evaluating fish which were descaled longitudinally along the side of the fish in the shape of a narrow band in most cases. Holding. tests conducted at McNary revealed that fish descaled in this manner died at about the same rate as "descaled fish".

The workshop group agreed that the criteria should be modified to include this group of fish.

The following language was adopted: IF THE SUMMATION OF SCALE LOSS IS EQUAL TO OR GREATER THAN 40% OF TWO OR MORE SECTIONS ON ONE SIDE OF THE FISH IT SHOULD BE CONSIDERED DESCALED AND SHALL BE DESIGNATED SEPERATLY WITH THE NUMBER 9.

By designating with the new #9, these fish can be segregated so the re-maning descaled fish can be compared to previous years. If you have any questions please give Steve Pettit or Chuck Koski a call.

In addition, a NEW category of cut and bruised (#8) was instituted. These fish should show severe signs of trauma: ie., black or discolored bruises the size of a dime or cuts which show obvious flesh.

We have worked up a new descaling form, which can be used at Snake River projects.

cc: Bob Raleigh'
Don Chapman
Duane Neitzel, Battell NW

EQUAL OPPORTUNITY EMPLOYER

FIGURE A.2. Letter From Steve Pettit, Idaho Fish and Game, Describing the 1985 Modifications to the Scale LOSS Evaluation Criteria

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APPENDIX B

RELEASE AND CAPTURE DATA FROM SUNNYSIDE CANAL FISH SCREENING FACILITY EVALUATION, SPRING 1985

RELEASE AND CAPTURE DATA FROM SUNNYSIDE CANAL FISH SCREENING FACILITY EVALUATION, SPRING 1985

The data presented in Tables 1 and 2 of the main text are combined data. That is, the individual trials within a test series were combined for a single estimate. The descaled fish are considered to be dead for these estimates. The combining of dead and descaled fish was also used in the evaluation of screen performance. The data from each of the replicate tests are presented here (Tables B.1 and B.2).

TABLE B.1. Percentage of Steelhead, *Salmo gairdneri*, Descaled or Killed in Each Test at the Sunnyside Canal Fish Screening Facility, Spring 1985

RELEASE SITE	TEST REPLICATE	NUMBER OF FISH: RELEASED	NUMBER OF FISH: CAPTURED	NUMBER OF FISH: DESCALED OR KILLED	FISH DESCALED OR KILLED (%)	95% CONFIDENCE INTERVAL
PRIMARY FISH RETURN PIPE	1	50	8	0	0	0-36.9
	2	50	16	0	0	0-20.6
	3	72	6	0	0	0-45.9
	control 1	50	8	0	0	0-36.0
	control 2	50	28	0	0	0-12.3
	control 3	55	21	0	0	0-16.1
INTERMEDIATE BYPASS	1	275	139	0	0	0-2.6
	control		24	0	0	0-14.3
TERMINAL BYPASS	1	200	112	0	0	0-3.2
	control		13	0	0	0-24.7
TRASH RACK	1	500	126	0	0	0-2.9
	control		19	0	0	0-17.7
CANAL HEADGATES	1	500	100	0	0	0-3.6
	control		20	0	0	0-16.8

TABLE B.2. Percentage of Chinook Salmon, *Oncorhynchus tshawytscha*, Descaled or Killed in each Test at the Sunnyside Canal Fish Screening Facility, Spring 1985

RELEASE SITE	TEST REPLICATE	NUMBER OF FISH			FISH DESCALED OR KILLED (%)	95% CONFIDENCE INTERVAL
		RELEASED	CAPTURED	DESCALED OR KILLED		
PRIMARY FISH RETURN PIPE	1	100	83	0	0	0-4.4
	2	100	64	2	3.1	0.4-10.8
	3	100	75	0	0	0-4.8
	4	100	60	1	1.7	0-8.9
	5	100	89	0	0	0-4.1
	control 1		36	0	0	0-9.7
	control 2	50	21	0	0	0-16.1
INTERMEDIATE BYPASS	1	100	82	2	2.4	0.3-8.5
	2	100	95	0	0	0-3.8
	3	100	99	0	0	0-3.7
	4	100	95	2	2.1	0.3-7.4
	5	100	97	0	0	0-3.7
	control		20	0	0	0-16.8
TERMINAL BYPASS	1	100	98	2	2.0	0.3-7.2
	2	100	96	1	1.0	0-5.7
	3	100	98	0	0	0-3.7
	4	100	98	3	3.1	0.6-8.7
	5	100	86	1	1.2	0-6.3
	control		20	0	0	0-16.8
TRASH RACK	1	1000	856	20	2.3	1.4-3.6
	control		20	0	0	0-16.8
CANAL HEADGATES	1	1000	729	6	0.7	0.2-1.6
	2	1000	725	21	3.2	2.0-4.7
	control		32	0	0	0-9.7